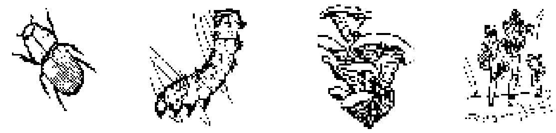
Forest Health Protection



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CHANGES IN FIRE-KILLED WESTERN LARCH ON THE GLACIER VIEW RANGER DISTRICT (FLATHEAD NATIONAL FOREST), MONTANA YEAR FIVE REPORT

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INTRODUCTION

This is the third of several reports describing progress in a ten- or more-year study evaluating changes of fire-killed western larch in northwestern Montana. Trees included were killed by the Moose Fire on the Flathead National Forest in fall 2001. This study evaluates more than 350 trees (240 dissected), looks at a large range of sizes (Table 1), and evaluates fire-killed trees over an extended period of time.

Table 1. Tree Locations and Site Characteristics

Site	Number of Trees Per Size Class[A]					Average Slope[B]	Aspect[C]	Habitat Type[D]	Central Elevation[E]
	1	2	3	4	Total				
1	67	30	7	1	105	25%	West	ABLA/CLUN	3,880
2	2	4	5	17	28	20%	Southwest	ABLA/LIBO	3,880
3	11	16	18	20	65	14%	Variable[F]	ABLA/CLUN	3,840
4	1	22	24	42	89	35%	West	ABLA/CLUN	3,720
5	5	16	38	21	80	38%	Northeast	ABLA/MEFE	4,100
Total	86	88	92	101	367				

[A] Number of trees tagged for each size class at each site. Size Class 1 = 8 to 11.9 inches dbh, Size Class 2 =12 to 15.9 inches dbh, Size Class 3 = 16 to 19.9 inches dbh, and Size Class 4 = 20 to 38 inches dbh.
[B] Average percent slope across site.
[C] Predominant aspect at the site.
[D] Predominant habitat type (h.t.) as defined in Pfister et al. (1977). Site 1 has some trees that are in ABLA/XETE h.t., Site 2 has some ABLA/XETE h.t. and PICEA/CLUN h.t., and Site 5 has some in the ABLA/CLUN h.t.
[E] Elevation in the geographic center of the site.
[F] Mostly southwest and northeast.

This report describes observations of all standing trees and dissections five years post-fire. For additional information about purpose, methods, and first through fourth year findings see Forest Health Protection Reports 04-16 (Jackson 2004) and 05-06 (Jackson and Bulaon 2005). More dissections are planned for seven and ten years post-fire.

METHODS

Standing Tree Evaluations

In early September 2006, all trees tagged in 2002 and not yet dissected were observed to determine if they were standing, had broken tops, sloughed bark, or conks present. Bark was considered "sloughed" when exposed wood could be seen as a result of separation of bark from wood and was not caused by woodpecker foraging or rubbing from nearby fallen trees. In the year four evaluation (Jackson and Bulaon 2005), all broken tops were counted, while in the year five evaluation only trees with broken tops below an estimated four inch diameter top were considered broken since four inches was identified as the minimum disk size. When conks were observed, fungal species and location of conks were noted.

Dissection Data

In mid September 2006, ten trees were dissected in each size class with wood borer, check, wood stain, and peripheral decay data collected. In the first two reports, the term 'sapwood decay' was used to describe decay around the periphery of the disks since almost all peripheral decay was confined to the sapwood during the first three years of dissections. Considerable decay that originated on the periphery of the disks moved into the heartwood prior to the year five dissections; therefore, 'peripheral decay' is a more appropriate term for description of post-fire initiated decay. Given variability in feller skill, breakage was not included in defects described in this report. Loss to breakage should be included in estimates of total merchantable volume.

RESULTS & DISCUSSION

Evaluation of All Standing Trees

Five years after the fire, no trees had fallen due to natural causes. Of the original 367 trees identified and tagged, one was removed from the data set because it was a Douglas-fir, one was lost to firewood cutters, 120 had been dissected, and the remaining 245 were still standing. Two hundred-sixteen (88%) of the standing trees had sloughing bark.

Twenty-eight (11%) of the 245 standing trees had broken tops. Only 11 of the 22 broken tops that were reported in a previous report (Jackson and Bulaon 2005) were included in the 28 identified as having broken tops in year five post-fire (see Methods above). Twenty-seven of the broken tops were at Site 1 while one broken top was at Site 2. The broken top at Site 2 occurred prior to the year four evaluation of all standing trees. Ten (37%) of the 27 trees at Site 1 were broken prior to the year four evaluation and 17 (63%) of the 27 trees were broken between the year four and year five standing tree evaluations. Although weather events (wind or heavy snow loads) may have been factors at Site 1, extensive wood borer activity and peripheral decay probably contributed significantly to the large number of broken tops at that site. Eight broken topped trees were dissected in 2006. Six of the eight dissected trees had extensive peripheral decay (40% to 90% of disk area) and six of the eight contained wood borer galleries in the highest disk (first disk directly below the break). All dissected trees with broken tops had extensive peripheral decay, five or more wood borer galleries, or a combination of decay and wood borer galleries in the disk directly below the break.

Fruiting bodies of the decay-causing fungus *Fomitopsis pinicola* (Swartz:Fr.) Karst were found on more than 1/3 of the trees and *Trichaptum abietinum* (Dickson:Fr.) Ryvarden

and *Cryptoporus volvatus* (Pk.) Shear were each observed on less than ten trees.

Dissection Data

Agent (wood borer, check, stain, and peripheral decay) data from dissections are summarized for each tree and size class in Table 2.

Wood Borers

Although no trends have developed regarding differences in wood-boring insect depth across size classes throughout this study (Jackson and Bulaon 2005; Table 2 of this report), wood borer holes per square foot of disk area decreased with increasing tree size every year including year five. The greater number of wood borer holes per square foot in the smaller diameter classes can probably best be explained by the fact that disk area increased exponentially as disk diameter increased incrementally. In previous years (Jackson and Bulaon 2005), it was noted that roughly the same number of insects attacked each disk; therefore, substantially more area was affected on smaller disks than larger disks and smaller trees than larger trees.

Checks

It's difficult to compare check data between years since there were no checks observed one year post-fire and abnormally high precipitation in the three months prior to data collection three years post-fire greatly reduced the number and

Table 2. Agent Data Summarized by Tree Five Years after the Moose Fire

Tree No.	DBH[A] (inches)	Age[B] (Years)	Site[C]	Deepest Borers[D] (mm)	Borer Holes/Sq. Foot[E]	Stain[F] (Percent)	Peripheral Decay[G] (Percent)	Deepest Check[H] (mm)	No. of Checks[I]	Sapwood Volume (Percent)[J]
929	8.2	91	5	18	0.7	1.3	0	119	2.1	57.9
923	8.7	84	5	60	3.9	6.0	3.9	92	1.3	46.0
619	8.9	87	1	20	2.5	1.7	9.7	77	0.6	38.7
548	9.7	81	1	24	7.7	6.6	10.9	90	1.4	35.5
583	10.3	88	3	79	10.4	0.7	0.8	68	1.3	36.7
535	10.5	81	1	61	9.4	0.5	17.1	95	0.8	37.7
624	10.8	81	1	40	10.0	1.3	49.8	95	0.7	44.5
611	11.3	82	1	40	8.7	2.5	31.1	60	0.4	38.5
683	11.6	183	3	25	3.8	1.8	2.5	40	2.4	22.8
543	11.8	88	1	60	12.6	3.6	12.0	107	0.7	33.2
MDC[K]	10.2	95	-	43	7.0	2.6	13.8	84.3	1.2	39.2
510	12.3	91	1	44	5.6	7.2	7.2	108	1.1	24.1
534	12.7	86	1	74	14.0	2.3	40.5	55	0.4	33.0
547	13.0	77	1	80	3.7	5.0	9.4	120	2.2	38.7
671	13.2	228	3	68	3.7	0.6	17.6	69	1.0	34.5
700	13.6	95	1	92	9.3	2.0	18.5	120	1.7	40.5
642	14.0	85	1	54	12.1	2.6	30.7	100	1.6	34.4
509	15.2	82	1	62	5.0	0.8	31.2	124	0.8	27.2
701	15.5	227	4	35	2.7	2.9	16.1	55	0.5	25.8
742	15.5	214	4	85	0.4	0.7	12.2	80	0.3	28.4
674	15.9	201	3	45	1.2	0.6	17.4	80	0.1	25.8
MDC	14.1	139	-	64	5.8	2.5	20.1	91.1	1.0	31.2
963	16.2	198	5	74	5.6	5.8	5.3	130	2.4	25.5
745	16.7	220	4	50	1.3	0.5	16.0	0	0	20.3
776	17.2	217	4	64	4.8	1.5	25.3	70	0.2	22.1
760	17.4	204	4	38	0.9	1.2	12.5	65	1.1	24.9
943	18.1	227	5	37	4.2	2.1	22.3	90	0.7	27.0
941	18.2	202	5	80	3.0	1.3	16.6	122	1.5	31.7
936	18.7	210	5	42	2.0	1.8	18.0	103	1.2	24.4
919	19.2	232	5	40	1.6	1.5	13.1	38	0.6	22.3
723	19.3	210	4	40	2.5	0.9	13.3	157	0.1	18.2
912	19.9	222	5	56	2.0	0.1	19.1	32	0.1	24.2
MDC	18.1	214	-	52	2.8	1.7	16.2	80.7	0.8	24.1
734	20.4	174	4	40	1.7	0.9	16.3	74	2.8	20.2
716	21.0	221	4	40	2.9	0.6	21.7	180	0.5	24.9
913	21.2	203	5	31	1.6	3.8	23.7	75	1.2	28.6
659	21.8	194	3	84	1.2	4.1	3.4	119	5.9	19.3
790	22.8	192	5	57	4.2	0.1	15.0	66	0.5	28.2
708	23.5	240	4	40	2.9	3.8	20.7	72	1.9	26.3
755	24.0	223	4	40	2.6	1.4	14.0	81	2.7	22.8
673	25.2	204	3	57	2.0	1.6	11.5	18	0.1	19.7
732	26.9	184	4	42	1.8	0.2	15.6	50	1.5	17.8
678	28.8	202	3	120	3.0	1.6	12.8	95	0.4	25.8
MDC	23.6	204	-	55	2.4	1.8	15.5	83	1.8	23.4

See legend on next page.

Legend for Table 2.

[A]Diameter at breast height (4.5 feet above ground level).

[B]Age-estimated by counting annual rings at the stump.

[C] Tree location (see Jackson 2004).

[D]Distance of wood borer hole that was furthest from the edge of wood on any disk from the tree.

[E]Average number of wood borer holes per square foot of disk area observed.

[F]Estimated percent cubic volume affected by sapwood stain. Estimated by calculating volume of each log using Smalian's Formula for a paraboloid frustum and multiplying total volume of the log by the mean of percent area affected by sapwood stain on disk at each end of the log. Total stain volume in the tree was then divided by total tree volume.

[G]Estimated percent cubic volume affected by peripheral decay. Estimated by calculating volume of each log using Smalian's Formula for a paraboloid frustum and multiplying total volume of the log by the mean of percent area affected by peripheral decay on disk at each end of the log. Total peripheral decay volume in the tree was then divided by total tree volume.

[H]Depth of deepest check found on any disk from the tree.

[I]Quotient when total number of peripheral checks on all disks are divided by total number of disks on that tree.

[J]Percent sapwood volume estimated by calculating total volume of each log and heartwood volume of each log using Smalian's Formula for a paraboloid frustum. Heartwood volume was then subtracted from total volume, with the difference divided by total volume and multiplied by 100.

[K]MDC - mean for diameter class. Mean for the ten values in diameter class, except wood borer depth means only include trees where wood borers were found.

size of visible checks for that year. Peripheral decay five years after the fire reduced the ability to adequately identify the number of small checks. However, the trend towards more checks in the largest diameter class compared to the three smaller diameter classes continued (Table 2). This may be due to greater surface area associated with larger disks on larger trees. No trend has developed regarding deepest checks for different size classes.

Stain

A reduction in stain of at least 50% in all size classes (Table 2) compared to measurements three years post-fire (Jackson and Bulaon 2005) were observed. Others have suggested that sapwood stain volume decreases in fire-killed conifers as some of the stained wood is consumed by sapwood decay fungi (Kimmey 1955; Hadfield and Magelssen 2006). This is probably why we observed less stain. The two smaller size classes contained a higher percentage of sapwood stain compared to the two larger size classes. Larger percent disk surface area containing sapwood in younger trees contributed to this difference.

Peripheral Decay

Peripheral decay has increasingly become a significant agent of change as time progressed (Jackson and Bulaon 2005). As with sapwood stain, percent peripheral decay is generally greater in smaller diameter trees due to a higher percentage of sapwood. However, peripheral decay accounted a greater proportion of more volume in the 12 to 16 inch dbh size class than the 8 to 12 inch dbh size class five years post-fire. One possible explanation for this discrepancy in the data is the broken tops. Five trees in the 12 to 16 inch size class had broken tops and three of the trees in the 8 to 12 inch size class had broken tops. Since percent peripheral decay generally decreased with increasing disk height above approximately 20 feet (Jackson and Bulaon 2005) and approximately two disks were lost above the breaks in the 12 to 16 inch size class, some solid wood was probably lost from those trees - increasing the overall decay percentage. Only one or no disks were lost from each of the broken trees in the 8 to 12 inch size class. A second explanation is the rate of decay may be different at various sites. Of the trees in Size Class 1, all four of the least decayed trees were in sites other than Site 1. A third explanation for the lower decay may be the effect that checks have on smaller diameter trees. Given the deepest check length and number of checks are similar in the three smaller size classes (Jackson and Bulaon 2005; Table 2 of this report); a larger portion of a tree in the smallest size class may be drying more quickly, causing the tree to be a less suitable substrate for decay-causing fungi. Future dissections should show whether decay slows in the smaller size classes as time progresses or if this discrepancy is purely a result of an inadequate sample size and/or due to the other explanations presented above.

REFERENCES CITED

Hadfield, J. S., and Magelssen. R. M. 2006. Wood Changes in Fire-Killed Tree Species in Eastern Washington. USDA For. Serv., Okanogan and Wenatchee National Forests, Wenatchee, WA. 49p.

Jackson, M.B. 2004. Changes in Fire-Killed Western Larch on the Glacier View Ranger District (Flathead National Forest), Montana: Establishment and Year One Report. USDA For. Serv. Forest Health Protection Rpt. 04-16. Missoula, MT. 13p.

Jackson, M.B. and B. Bulaon. 2005. Changes in Fire-Killed Western Larch on the Glacier View Ranger District (Flathead National Forest), Montana: Years Two, Three, and Four Report. USDA For. Serv. Forest Health Protection Rpt. 05-06. Missoula, MT. 20p.

Kimmey, J.W. 1955. Rate of Deterioration of Fire-killed Timber in California. USDA Circular No. 962. 22p.

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